REMARKS

In the Office Action dated January 9, 2006, claims 1, 7-14, 17, 18, 26-28, and 30 were rejected under 35 U.S.C. § 112, ¶ 1; claims 1-8, 26, and 27 were rejected under § 112, ¶ 2; claims 1-18 and 29 were rejected under § 103 over U.S. Patent No. 5,686,349 (Nakata '349) in view of U.S. Patent No. 6,271,062 (Nakata '062); claims 1, 26, 29, and 30 were rejected under § 103 over U.S. Patent No. 6,919,266 (Anh) in view of U.S. Patent No. 6,833,161 (Wang).

Claims 19-21 and 22-23 have been cancelled without prejudice to submitting the claims in a divisional application.

REJECTION UNDER 35 U.S.C. § 112, ¶ 1 (LACK OF ENABLEMENT)

The claims have been amended to recite "SiH_4" and "SiH_2" instead of "first gas" and "second gas." This was noted by the Office Action as being enabled.

REJECTION UNDER 35 U.S.C. § 112, ¶ 1 (LACK OF WRITTEN DESCRIPTION)

Claim 30 was rejected as failing to comply with the written description requirement. Support for the subject matter of claim 30 can be found in ¶¶ [033], [036], and [039] and Fig. 3(b) of the Specification. Paragraph [033] mentions that during the source depositing process depicted in Fig. 3(b), a large number of SiH_2 molecules obtained in the source supplying process are adsorbed on the surface of substrate 2 and Si atoms bond to each other to form microcrystals. Paragraph [036] mentions that a majority of SiH_4 supplied before the process of Fig. 3(a) was adsorbed on the crystal surface in the source depositing process. Paragraph [039] mentions that the source depositing process is given enough time for most of the SiH_2 in the vapor phase to be adsorbed on the substrate surface.

In view of the foregoing, it is clear that the subject matter of claim 30 has adequate written description in the Specification.

REJECTION UNDER 35 U.S.C. § 112, ¶ 2

Claim 1 has been amended to overcome the indefiniteness rejection.

REJECTION UNDER 35 U.S.C. § 103

No prior art rejections have been asserted against claims 27 and 28. In view of the fact that the § 112 rejections of these claims have been overcome, it is respectfully requested that these claims be indicated as containing allowable subject matter.

Since independent claims 1 and 29 have been amended to recite supplying SiH_4 and H_2, the rejections over Wang and Anh have been rendered moot—note that the Office Action did not reject the claims reciting SiH_4 and H_2 over Wang and Anh.

Also, since dependent claim 26 was not rejected over Nakata '349 and Nakata '062, an indication of allowability of claim 26 is also respectfully requested. Newly added dependent claim 31 (which depends from claim 29) is also similarly allowable.

It is respectfully submitted that claim 1 is not obvious over Nakata '349 in view of Nakata '062. The Office Action conceded that Nakata '349 does not teach depositing a microcrystalline thin film during the second process. 1/9/2006 Office Action at 7.

However, the Office Action maintained that after the stop of SiH_4 in Nakata '349, that the "process of Nakata '349 inherently results in at least a quantitative amount of continual deposition, during the second step, at which H_2 is maintained at a constant rate, due to the presence of SiH_4 and H_2 remaining in the process chamber." 1/9/2006 Office Action at 7-8. The Office Action asserted that "residual SiH_4 remaining in the process chamber with the constant flow of H_2 will result in a H_2 to SiH_4 dilution ratio to deposit a quantitative amount of microcrystalline thin film directly from the vapor phase, See Nakata '062 . . . ." *Id.* at 8.

The reference to residual SiH_4 remaining in the process chamber of Nakata '349 during the hydrogen plasma treatment phase of Nakata '349, and that this residual SiH_4 would deposit a microcrystalline thin film does not find any support in the teachings of Nakata '349. In fact, what the Office Action has appeared to have ignored is that Nakata '349 specifically teaches a solution in Example 2 that would have taught a person of ordinary skill in the art that depositing a microcrystalline thin film (rather than depositing an amorphous film) is possible *if both* SiH_4 and H_2 were *continuously* supplied (but with the flow rate of H_2 changed after an initial period). Nakata '349, 7:43-53. Example 2 of Nakata '349 indicates that the initial H_2/SiH_4 ratio is 200 or more, with the flow rate of H_2 subsequently reduced to achieve a dilution ratio of 2-100. As explained by both Nakata '349 and Nakata '062 (the reference combined with Nakata '349 in the

obviousness rejection), the reduction of the dilution ratio of H_2 to SiH_4 is possible after the initial layer (about 100 angstroms) of microcrystalline thin film has been formed to continue depositing the microcrystalline thin film. *See* Nakata '349, 7:54-62; Nakata '062, 5:19-26; 11:37-44.

Thus, a person of ordinary skill in the art looking to the teachings of Nakata '349 and Nakata '062 would have been taught the following: to deposit a microcrystalline thin film in a *second* phase, microcrystalline thin film must first be deposited in a *first* phase by supplying *both* SiH_4 and H_2, followed by the second phase during which *both* SiH_4 and H_2 are also supplied (with the flow rate of H_2 reduced in the second phase) to continue depositing the microcrystalline thin film. Such a process is quite different from the subject matter of claim 1. In fact, in the Example 1 embodiment of Nakata '349, if the Examiner were correct and there was residual SiH_4 remaining, then the remaining SiH_4 would be deposited onto the *amorphous* silicon layer as *amorphous* silicon, not microcrystalline silicon.

In the Example 1 embodiment of Nakata '349, deposition of an *amorphous* silicon layer on the substrate occurs during the first time period in which the material gas (SiH_4) and hydrogen gas are introduced. Nakata '349, 5:45-58. On the other hand, during the period in which only the hydrogen gas is introduced, the *amorphous* silicon layer that *has been deposited* on the substrate 10 is subjected to a hydrogen plasma treatment to convert the deposited amorphous silicon layer into a microcrystalline layer. Nakata '349, 5:58-61; 6:26-28; 7:18-20. (Note that the Example 1 technique described in Nakata '349 corresponds to the technique described in paragraphs [06]-[08] of the Background section of the present application that certain embodiments of the present invention seek to improve upon).

What Nakata '349 clearly teaches is that the SiH_4 supplied during the first phase is used to form *amorphous* silicon. There is no teaching or suggestion, inherent or otherwise, that the application of plasma treatment during the second phase would cause *deposition* of a microcrystalline thin film. There is no suggestion in Nakata '349 of residual SiH_4 during the second phase, and there certainly is no suggestion in Nakata '349 that any deposition of a microcrystalline thin film is being performed during the second phase. In fact, depositing any such residual SiH_4 on an amorphous silicon layer would cause further deposition of amorphous silicon.

Therefore, it is respectfully submitted that claim 1 is non-obvious over Nakata '349 and Nakata '062.

Independent claim 29 is also non-obvious over Nakata '349 and Nakata '062 for similar reasons. Claim 29 recites supplying SiH_4 and H_2 to a chamber in which a substrate is located, and depositing the microcrystalline thin film on the substrate, where prior to depositing the microcrystalline thin film, the supply of SiH_4 to the chamber is stopped.

Independent claim 9 is also allowable over Nakata '349 and Nakata '062. Claim 9 recites a method of forming a microcrystalline thin film by activating SiH_4, and forming a film having a microcrystalline structure on a film forming target object, wherein activating SiH_4 comprises applying an electric field to break down SiH_4 to SiH_2.

The Office Action conceded that Nakata '349 fails to teach converting SiH_4 to SiH_2. 1/9/2006 Office Action at 8. However, the Office Action pointed to a discussion in the Background section of the present specification (on page 3) as providing an admission that Nakata '349 applies such an electric field to break down SiH_4 to SiH_2. *Id.* It is respectfully submitted that there existed no suggestion to apply the teachings on page 3 of the Background section of the present specification to Nakata '349. Nakata '349 in "Example 1" clearly teaches that the SiH_4 supplied during the first phase is used to form an amorphous silicon layer. Whether SiH_2 is formed or not in the first phase is *irrelevant*—Nakata '349 is unambiguous in stating that the supplied SiH_4 is used to form amorphous silicon in the first phase. In other words, any gas used to form the amorphous silicon layer in the first phase of Nakata '349 would *not* be used to deposit a microcrystalline film during the second phase. Also, as noted above, there existed no motivation to modify the teachings of Nakata '349 based on the teachings of Nakata '062 to achieve the claimed subject matter.

Therefore, claim 9 is non-obvious over Nakata '349 and Nakata '062.

Dependent claims are allowable for at least the same reasons as corresponding independent claims.

In view of the foregoing, allowance of all claims is respectfully requested. The Commissioner is authorized to charge any additional fees and/or credit any overpayment to Deposit Account No. 20-1504 (CMO.0012US).

Respectfully submitted,

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